Current Maths Research

Research review series: mathematics

Source: Ofsted https://www.gov.uk/government/publications/research-review-series-mathematics/research-review-series-mathematics

Date: 25th May 2021

Summary

There are a variety of ways that schools can construct and teach a good mathematics curriculum. However, the review identifies some common features of successful, high-quality curriculum approaches:

- "Teachers engineer the best possible start for all pupils by closing the school entry gap in knowledge of basic mathematical facts, concepts, vocabulary and symbols.
- The teaching of maths facts and methods is sequenced to take advantage of the way that knowing those facts helps pupils to learn methods
- Throughout sequences of learning, pupils benefit from teaching that is systematic and clear.
- The aim is for pupils to attain proficiency to ensure motivation and to have confidence in the subject.
- Pupils need regular opportunities to practice and use the important mathematical knowledge
- Assessment should always respond to gaps in learning and is most useful when it focuses on the component knowledge that pupils have learned.
- Calculations should be systematic and orderly, to enable them to spot errors and make clear connections."

Key Vocabulary

• **Fluency** has multiple meanings: the ease of recall and automaticity and conceptual knowledge.

• **Procedural knowledge** is recalled as a sequence of steps. All procedural content can be used in a stem sentence "I know how".

• **Conditional knowledge** gives pupils the ability to reason and problem solve. All conceptual knowledge can be used in a stem sentence "I know when".

Planning the curriculum

• The mathematics curriculum should be sequenced to ensure the guarantee of long-term learning.

• All strategies for problem solving should only be taught once fluency has been achieved. Problem-solving strategies are best taught once pupils can 'recall and deploy facts and methods with speed and accuracy'.
• New content should 'draw on and make links with' previously acquired knowledge following a carefully sequenced curriculum that is 'intelligently designed'.
• Before more complex strategies are taught, pupils should be confident using the linked facts and methods that form the strategy's 'building blocks'.
• Foundational success in maths underpins maths positivity and leads to improved results. Ensuring that pupils acquire 'core mathematical knowledge' will allow them to start to experience success and therefore begin to associate maths with 'enjoyment and motivation'.
• Early curriculum emphasis on core facts and concepts is key to closing the gaps in knowledge. Teachers should help pupils to develop 'automatic recall' of key concepts to prevent their working memory from becoming overloaded.
• Striving for equity in your curriculum means better outcomes for all. Wherever possible goals should be to keep all pupils learning together as it raises the bar for the lower attainers. Pupils should not be rushed through a topic and some may need more time than others. The curriculum should be adapted to meet he needs of *all* learners.

"Pupils with SEND benefit hugely from explicit, systematic instruction and systematic rehearsal of declarative and procedural knowledge."

Where maths interventions are required one to one teaching is consistently shown to be one of the most effective methods of accelerating learning and filling in gaps provided it is fully personalised to the individual's needs and prior knowledge.

• Teach problem solving explicitly and in context

Strategies for problem-solving should be topic specific and can therefore be planned into the sequence of lessons as part of the wider curriculum. Pupils who are already confident with the foundational skills may benefit from a more generalised process involving identifying relationships and weighing up features of the problem to process the information.

Open-ended problem solving tasks do not necessarily mean that the activity is the 'ideal means of acquiring proficiency'. Open ended problem-solving activities – while enjoyable – may not necessarily lead to improved results. Worked examples, careful questioning and constructing visual representations can help pupils to convert information embedded in a problem into mathematical notation.

• Look at the quality and quantity of topic consolidation and low stakes assessments

Teachers should plan frequent, low-stakes assessments throughout the 'learning journey' to help pupils prepare for assessments that focus on what pupils have actually learnt.

Using low stakes testing to ensure that pupils are well-prepared for assessments will not only increase knowledge retention, but also improve pupils confidence in maths.

Using lessons to incorporate timed testing can help pupils to develop fluency and give teachers the reassurance that 'pupils are not reliant on derivation' to calculate their answers.

By planning assessments to 'engineer proficiency' and promote success, pupils can see tests as 'moments to shine' and even look forward to them.

• School-wide systems are best for pupil progress and teacher development

There can be a place for 'messy experimental workings', but through teachers modelling and planned opportunities to rehearse well-structured methods, they can provide opportunities for pupils to learn how to be 'systematic, logical and accurate when applying taught facts, methods and strategies'.

Source: NCETM (National Centre for Excellence in the Teaching of Mathematics)

Date: August 2018

Summary:

- The central idea of teaching with variation is to highlight the essential features through varying the non-essential.
- Place emphasis on 'what is' and 'what is not'
- Variation is not the same as variety – careful attention needs to be paid to what aspects are being varied and for what purpose.

Source: Cambridge Maths Hub – Procedural Variation

Date: 2018

Summary:

- People are naturally curious, but we are not naturally good thinkers; unless the cognitive conditions are right, we will avoid thinking.
- Variety is pick and mix and most practice will contain variety. Whereas variation, means there has been a careful choice of what to vary and what that variation will draw attention to.
- Conceptual variation draws attention to what something is and what something is not. For example: a triangle and not a triangle.
- Procedural variation
    - Is dynamic and shows how to move from one aspect to another and the relationship between the two.
    - It will focus on the relationships and not just the procedure.
    - Enables children to make connections between problems, using one to solve the next.

- Types of questions to ask: What do you notice? What is different? What is the same?

Source: Maths Hub (Ofsted give further reassurance to school using mastery approach to mathematical teaching)

Date: November 2019

Summary:

- Depth of understanding should be prioritised, alongside high expectations of every child.
- Mathematics teaching should create a deeper understanding rather than accelerate pupils into new content.

Source: Ofsted (Mathematics master primary conference)

Date: 2015

Summary:

- All children should become fluent in the fundamentals of mathematics, reason mathematically and solve problems.
- Differentiation should emphasise deep knowledge and individual support or intervention.
- A mastery curriculum often involves whole class teaching, with all pupils being taught the same concepts at the same time. Small groups work will typically involve challenge through greater depth for the more able and support with grasping concepts and methods for the less able pupils.
- Variation in set exercises should concentrate on the same topic/method/concept but vary in how the questions are presented, often in ways that expose the underlying concept or mathematical structure, and make pupils think deeply for themselves.